Study of the Acoustic Properties of Critical Solutions

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A specific contribution to the absorption of sound, related to the concentration fluctuations, is observed in binary solutions near the critical point of stratification. Frequency and temperature dependencies of this absorption can be described by Kawasaki theory, which is based on the fact that a lag in the phase response of the system to the applied sinusoidal sound perturbation results in dissipation of the acoustic energy. Examinations of this idea were carried out mostly for systems with an upper critical point of stratification (UCPS). Solutions with a lower critical point of stratification (LCPS) should be investigated independently, due to a different molecular mechanism of stratification. We carried out investigations of acoustic relaxation in aqueous solution of 2,6 dimethyl-pyridine (lutidine) with LCPS. The critical temperature of stratification was 319 K, and critical concentration was 0.06 m.f. of lutidine. Measurements of the acoustic absorption were carried out in frequency region from 0.05 to 1000 MHz. Temperature of the sample near the stratification point was controlled within 0.003 K. Our results show that in the frequency region 0.3-1 MHz the magnitude of the absorption coefficient divided by the squared frequency was independent on the acoustic frequency. Near the critical point, the frequency dependence of sound absorption is similar to that for solutions with UCPS. However, while moving away from the critical point, we observed some deviation from usual behavior. With decreasing frequency, the absorption tends to a plateau with further increase that indicates the existence of another relaxation mechanism. The lutidine-water solution is one of the most suitable systems to search for unambiguous deviations in the dependence of the reduced absorption on reduced frequency due to entropy fluctuations. The obtained results show that the absorption, related to the entropy fluctuations, is small, and, obviously, cannot be observed in any real binary systems.